ZOOX INC
325 SHARON PARK DR #909,
MENLO PARK, CA 94025, USA
WILD@ZOOX.COM

ZOOX.COM

DATE:

March 14, 2018

TO:
**California Department of Motor Vehicles**
Occupational Licensing Branch
2570 24th St.
Sacramento, CA
ATTN: Elizabeth Humphreys, Mail Station H325

**RE: Supplement to the Annual Report of AV Mode Disengagements**

Dear Ms. Humphreys,

Zoox submits the following data as a supplement to our annual report of AV mode disengagements, submitted on December 31, 2017.

A *planning discrepancy* is when the autonomous system disengages and the safety driver resumes control because of a limitation of the vehicle's planning system. A *perception discrepancy* is when the autonomous system disengages and the safety driver resumes control because of a limitation of the vehicle's perception system. A *hardware discrepancy* is when the autonomous system disengages and the safety driver resumes control because of a failure of a piece of hardware.

Please feel free to follow up with me if you have any additional questions.

Sincerely,

Mark R. Rosekind

Mark R. Rosekind, Ph.D.
**Chief Safety Innovation Officer**

DECEMBER 31, 2017

# ZOOX IS DRIVING WHERE IT MATTERS – CITIES.

– 95% OF PUBLIC AUTONOMOUS MILES DRIVEN IN DOWNTOWN SAN FRANCISCO
– 430 MILES FOR EVERY ONE DISENGAGEMENT IN NOVEMBER 2017

Zoox is building a scalable, next-generation autonomous transportation solution for cities that will enhance safety, mobility, and sustainability. In the U.S., 94 percent of crashes are caused by human choice or error. Specifically, in San Francisco, every year about 30 people lose their lives and over 200 more are seriously injured while traveling on city streets, as a result of these human factors. Autonomous mobility offers an opportunity to save lives and prevent injuries and crashes on our roadways.

Cities are complex and dynamic. Zoox is creating an autonomous system with novel vehicles designed to safely share the road with pedestrians, cyclists, public transit, emergency vehicles, and other road users. On the streets of San Francisco, our test system often sees more in 100 feet than a vehicle might experience over 100 miles on a freeway. During a recent 30-minute drive in downtown San Francisco, our system detected 503 pedestrians, 188 bicyclists and 2,741 cars.

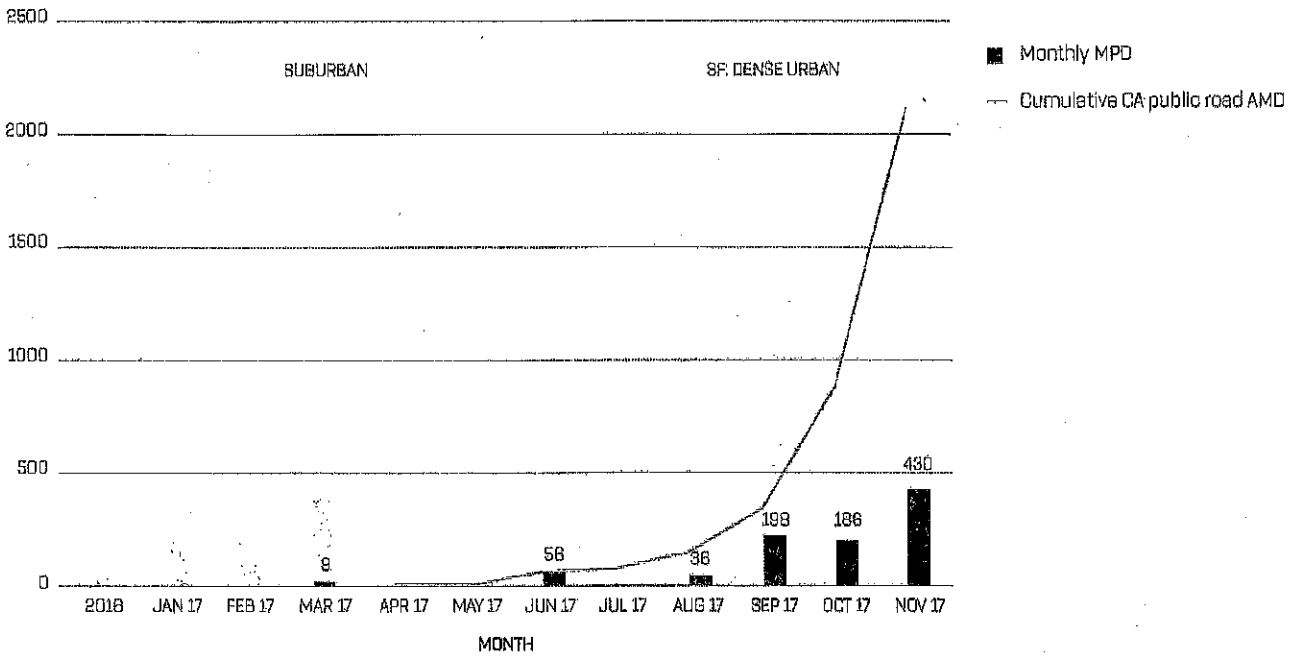
In 2017, after development and maturation of our advanced self-driving-system on a private test track, Zoox expanded to autonomous driving on California public roads, where we drove 2,244 miles. Of those public road miles, 95% were driven in downtown San Francisco. At no time when our test fleet was in autonomous-mode were they involved in an incident; at Zoox 'safety first' is our foundation. Over the course of this reporting period (our first), we increased our miles per disengagement (MPD). We ended this period with 430 miles for every one disengagement in this dense urban environment.

This report provides data on Zoox's 2017 progress driving autonomous miles on public roads in California. All disengagements took place during planned tests.

# ZOOX PROGRESS

Over time, both the number of autonomous miles Zoox has driven on California roads and the number of miles driven between disengagements has increased.

**ZOOX CALIFORNIA PUBLIC ROAD AUTONOMOUS MILES DRIVEN (AMD) AND MILES PER DISENGAGEMENT (MPD)**



# APPENDIX 1

## TOTAL NUMBER OF ZOOX FLEET MILES DRIVEN AUTONOMOUSLY ON CALIFORNIA PUBLIC ROADS FOR EACH MONTH OF THE REPORTING PERIOD.

| VEHICLE VIN | MAR 16-DEC 16 | JAN 17 | FEB 17 | MAR 17 | APR 17 | MAY 17 | JUN 17 | JUL 17 | AUG 17 | SEP 17 | OCT 17 | NOV 17 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| -8917 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| -6725 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7.0 | 38.0 | 27.7 | 94.7 |
| -7703 | 0 | 10.5 | 0 | 44.1 | 0 | 0 | 1.5 | 0 | 1.2 | 21.9 | 157.2 | 210.8 |
| -7625 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 71.3 | 229.5 | 262.0 |
| -6144 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 11.7 | 32.6 | 63.8 | 248.6 |
| -5942 | 0 | 0 | 0 | 0 | 0 | 0 | 19.2 | 6.8 | 11.4 | 0.2 | 44.4 | 156.4 |
| -9889 | 0 | 0 | 0 | 0 | 2.2 | 0 | 35.4 | 0 | 1.8 | 0 | 0 | 181.9 |
| -5009 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| -5016 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| -8842 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4.9 | 39.2 | 34.7 | 37.2 | 124.2 |
| -0015 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

# APPENDIX 2

## DESCRIPTIONS OF DISENGAGEMENTS FROM AUTONOMOUS MODE*

| DATE | LOCATION & WEATHER CONDITIONS | FACTS | TIME TO DRIVER INTERVENTION | CAUSE |
|---|---|---|---|---|
| Nov 17 | Dense Urban Street, clear weather | Planning discrepancy, system indicated incorrect yield at intersection | – | Failure detection |
| Nov 17 | Dense Urban Street, clear weather | Planning discrepancy, system indicated incorrect merge | – | Failure detection |
| Nov 17 | Dense Urban Street, clear weather | Perception discrepancy, system indicated incorrect yield | – | Failure detection |
| Oct 17 | Dense Urban Street, clear weather | Planning discrepancy, system indicated incorrect yield at intersection | – | Failure detection |
| Oct 17 | Dense Urban Street, clear weather | Planning discrepancy, incorrect system startup caused system error | – | Failure detection |
| Oct 17 | Dense Urban Street, clear weather | Hardware discrepancy, loss of power to a sensor | – | Failure detection |
| Sep 17 | Dense Urban Street, clear weather | Planning discrepancy, system indicated incorrect size of large vehicle extending into adjacent lanes | – | Failure detection |
| Aug 17 | Dense Urban Street, clear weather | Hardware discrepancy, localization hardware issue causing system to return to manual mode | – | Safe operation |
| Aug 17 | Dense Urban Street, clear weather | Planning discrepancy, system did not yield for a fast-moving pedestrian | – | Failure detection |
| Jun 17 | Suburban Street, clear weather | Planning discrepancy, system indicated a poor trajectory after incorrect determination of actions of another vehicle | – | Failure detection |
| Mar 17 | Suburban Street, clear weather | Hardware discrepancy, localization hardware issue causing system to return to manual mode | 0.7 sec | Safe operation |
| Mar 17 | Suburban Street, clear weather | Hardware discrepancy, localization hardware issue causing system to return to manual mode | 0.8 sec | Safe operation |
| Mar 17 | Suburban Street, clear weather | Hardware discrepancy, localization hardware issue causing system to return to manual mode | 0.8 sec | Safe operation |
| Mar 17 | Suburban Street, clear weather | Planning discrepancy, system indicated incorrect trajectory | – | Failure detection |

* Dash (-) indicates safety driver took immediate manual control.